

## CD4002M/CD4002C Dual 4-Input NOR Gate CD4012M/CD4012C Dual 4-Input NAND Gate

### General Description

These NOR and NAND gates are monolithic complementary MOS (CMOS) integrated circuits. The N- and P-channel enhancement mode transistors provide a symmetrical circuit with output swings essentially equal to the supply voltage. This results in high noise immunity over a wide supply voltage range. No DC power other than that caused by leakage current is consumed during static conditions. All inputs are protected against static discharge and latching conditions.

### Features

- Wide supply voltage range
- Low power
- High noise immunity

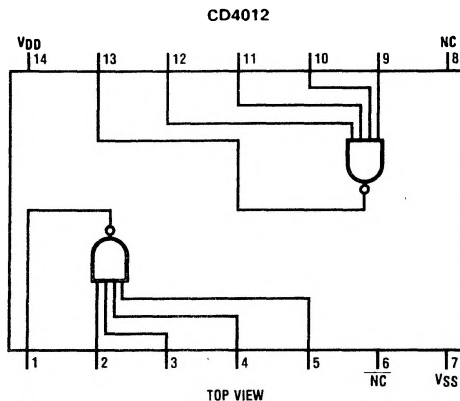
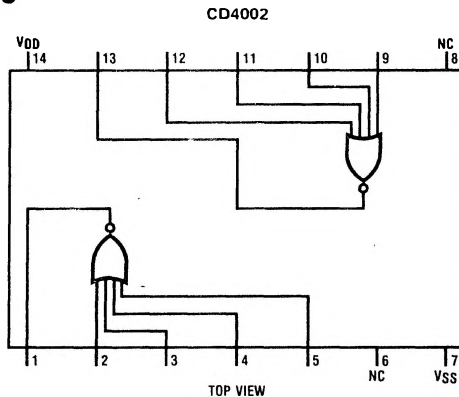
3.0 V to 15 V  
10 nW (typ.)  
0.45 V<sub>DD</sub> (typ.)

### Applications

- Automotive
- Data terminals
- Instrumentation
- Medical Electronics

- Alarm system
- Industrial controls
- Remote metering
- Computers

### Connection Diagrams



### Absolute Maximum Ratings (Note 1)

Voltage an Any Pin  $V_{SS} - 0.3V$  to  $V_{DD} + 0.3V$   
 Operating Temperature Range  
 CD4002M, CD4012M  $-55^{\circ}C$  to  $+125^{\circ}C$   
 CD4002C, CD4012C  $-40^{\circ}C$  to  $+85^{\circ}C$

Storage Temperature Range  $-65^{\circ}C$  to  $+150^{\circ}C$   
 Package Dissipation 500 mW  
 Operating  $V_{DD}$  Range  $V_{SS} + 3.0V$  to  $V_{SS} + 15V$   
 Lead Temperature (Soldering, 10 seconds)  $300^{\circ}C$

### DC Electrical Characteristics – CD4002M, CD4012M

Parameter	Conditions	Limits						Units	
		$-55^{\circ}C$		$25^{\circ}C$		$125^{\circ}C$			
		Min.	Max.	Min.	Typ.	Max.	Min.		Max.
$I_L$ Quiescent Device Current	$V_{DD} = 5.0V$		0.05		0.001	0.05		3.0	$\mu A$
	$V_{DD} = 10V$		0.1		0.001	0.1		6.0	$\mu A$
$P_D$ Quiescent Device Dissipation/Package	$V_{DD} = 5.0V$		0.25		0.005	0.25		15	$\mu W$
	$V_{DD} = 10V$		1.0		0.01	1.0		60	$\mu W$
$V_{OL}$ Output Voltage Low Level	$V_{DD} = 5.0V, V_I = V_{DD}, I_O = 0A$		0.05		0	0.05		0.05	V
	$V_{DD} = 10V, V_I = V_{DD}, I_O = 0A$		0.05		0	0.05		0.05	V
$V_{OH}$ Output Voltage High Level	$V_{DD} = 5.0V, V_I = V_{SS}, I_O = 0A$	4.95		4.95	5.0		4.95		V
	$V_{DD} = 10V, V_I = V_{SS}, I_O = 0A$	9.95		9.95	10		9.95		V
$V_{NL}$ Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O = 3.6V, I_O = 0A$	1.5		1.5	2.25		1.4		V
	$V_{DD} = 10V, V_O = 7.2V, I_O = 0A$	3.0		3.0	4.5		2.9		V
$V_{NH}$ Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O = 0.95V, I_O = 0A$	1.4		1.5	2.25		1.5		V
	$V_{DD} = 10V, V_O = 2.9V, I_O = 0A$	2.9		3.0	4.5		3.0		V
$I_{DN}$ Output Drive Current N-Channel (4002)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$	0.5		0.40	1.0		0.28		mA
	$V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	1.1		0.9	2.5		0.65		mA
$I_{DP}$ Output Drive Current P-Channel (4002)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$	-0.62		-0.5	-2.0		-0.35		mA
	$V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.62		-0.5	-1.0		-0.35		mA
$I_{DN}$ Output Drive Current N-Channel (4012)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$	0.31		0.25	0.5		0.175		mA
	$V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	0.63		0.5	0.6		0.35		mA
$I_{DP}$ Output Drive Current P-Channel (4012)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$	-0.31		-0.25	-0.5		-0.175		mA
	$V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.75		-0.6	-1.2		-0.4		mA
$I_I$ Input Current					10				pA

# DC Electrical Characteristics — CD4002C, CD4012C

CD4002M/CD4002C, CD4011M/CD4012C

Parameter	Conditions	Limits						Units	
		-40°C		25°C			85°C		
		Min.	Max.	Min.	Typ.	Max.	Min.		Max.
$I_L$ Quiescent Device Current	$V_{DD} = 5.0V$ $V_{DD} = 10V$		0.5 5.0		0.005 0.005	0.5 5.0		15 30	$\mu A$ $\mu A$
$P_D$ Quiescent Device Dissipation/Package	$V_{DD} = 5.0V$ $V_{DD} = 10V$		2.5 50		0.025 0.05	2.5 50		75 300	$\mu W$ $\mu W$
$V_{OL}$ Output Voltage Low Level	$V_{DD} = 5.0V, V_I = V_{DD}, I_O = 0A$ $V_{DD} = 10V, V_I = V_{DD}, I_O = 0A$		0.05 0.05		0 0	0.05 0.05		0.05 0.05	V V
$V_{OH}$ Output Voltage High Level	$V_{DD} = 5.0V, V_I = V_{SS}, I_O = 0A$ $V_{DD} = 10V, V_I = V_{SS}, I_O = 0A$	4.95 9.95		4.95 9.95	5.0 10		4.95 9.95		V V
$V_{NL}$ Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O \geq 3.5V, I_O = 0A$ $V_{DD} = 10V, V_O \geq 7.2V, I_O = 0A$	1.5 3.0		1.5 3.0	2.25 4.5		1.4 2.9		V V
$V_{NH}$ Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O \leq 1.5V, I_O = 0A$ $V_{DD} = 10V, V_O \leq 3.5V, I_O = 0A$	1.4 2.9		1.5 3.0	2.25 4.5		1.5 3.0		V V
$I_{DN}$ Output Drive Current N-Channel (4002)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	0.35 0.72		0.3 0.6	1.0 2.5		0.24 0.48		mA mA
$i_{DP}$ Output Drive Current P-Channel (4002)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.35 -0.3		-0.3 -0.25	-2.0 -1.0		-0.24 -0.2		mA mA
$I_{DN}$ Output Drive Current N-Channel (4012)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	0.145 0.3		0.12 0.25	0.5 0.6		0.095 0.2		mA mA
$I_{DP}$ Output Drive Current P-Channel (4012)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.145 -0.35		-0.12 -0.3	-0.5 -1.2		-0.095 -0.24		mA mA
$I_I$ Input Current					10				$\mu A$

### AC Electrical Characteristics

$T_A = 25^\circ\text{C}$ ,  $C_L = 15\text{pF}$ , and input rise and fall times = 20ns.  
Typical temperature coefficient for all values of  $V_{DD} = 0.3\%/^\circ\text{C}$

Parameter	Conditions	Min.	Typ.	Max.	Units
<b>CD4002M</b>					
$t_{PHL}$ Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	50 40	ns ns
$t_{PLH}$ Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	50 40	ns ns
$t_{THL}$ Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	175 75	ns ns
$t_{TLH}$ Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	125 70	ns ns
$C_{IN}$ Input Capacitance	Any Input		5.0		pF
<b>CD4002C</b>					
$t_{PHL}$ Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	120 65	ns ns
$t_{PLH}$ Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	80 55	ns ns
$t_{THL}$ Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	300 125	ns ns
$t_{TLH}$ Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	200 115	ns ns
$C_{IN}$ Input Capacitance	Any Input		5.0		pF

### AC Electrical Characteristics

$T_A = 25^\circ\text{C}$ ,  $C_L = 15\text{pF}$ , and input rise and fall times = 20ns.  
Typical temperature coefficient for all values of  $V_{DD} = 0.3\%/^\circ\text{C}$

Parameter	Conditions	Min.	Typ.	Max.	Units
<b>CD4012M</b>					
$t_{PHL}$ Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	75 40	ns ns
$t_{PLH}$ Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	75 40	ns ns
$t_{THL}$ Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 50	125 75	ns ns
$t_{TLH}$ Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 40	100 60	ns ns
$C_{IN}$ Input Capacitance	Any Input		5.0		pF
<b>CD4012C</b>					
$t_{PHL}$ Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	100 50	ns ns
$t_{PLH}$ Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	100 50	ns ns
$t_{THL}$ Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 50	150 100	ns ns
$t_{TLH}$ Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 40	125 75	ns ns
$C_{IN}$ Input Capacitance	Any Input		5.0		pF

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.